MIL-S-19500/180D
9 October 1967
SUPERSEDING
MIL-S-19500/180C(EL)
12 December 1966

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, MEDIUM-POWER

TYPES 2N1483, TX2N1483, 2N1484, TX2N1484

2N1485, TX2N1485, 2N1486, TX2N1486

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a NPN, silicon, medium-power transistor. The prefix "TX" is used on devices submitted to and passing the special process-conditioning, testing, and screening as specified in 4.5 through 4.5.8.1.

1.2 Physical dimensions. See figure 1 (TO-8).

1.3 Maximum ratings.

Types	P_T 1/ T_A = 25° C	P_T 2/ T_C = 25° C	V_{CBO}	V_{EBO}	V_{CEO}	I_C	T_{stg}	T_J
	W	W	Vdc	Vdc	Vdc	Adc	°C	°C
2N1483, 2N1485	1.75	25	60	12	40	3.0	-65 to +200	+200
2N1484, 2N1486	1.75	25	100	12	55	3.0	-65 to +200	+200

1/ Derate linearly 0.010 W/°C for $T_A > 25°$ C.

2/ Derate linearly 0.143 W/°C for $T_C > 25°$ C.

1.4 Primary electrical characteristics.

	h_{FE} 1/ V_{CE} = 4.0 Vdc I_C = 750 mAdc		V_{BE} 1/ V_{CE} = 4.0 Vdc I_C = 750 mAdc	$V_{CE(sat)}$ 1/ I_C = 750 mAdc		I_{CBO}		I_{EBO} V_{EB} = 12 Vdc	f_{hfb} V_{CB} = 28 Vdc I_C = 5.0 mAdc
				I_B = 75 mAdc	I_B = 40 mAdc	V_{CB} = 30 Vdc	V_{CB} = 50 Vdc		
	2N1483	2N1485		2N1483	2N1485	2N1483	2N1484		
	2N1484	2N1486		2N1484	2N1486	2N1485	2N1486		
			Vdc	Vdc	Vdc	μAdc		μAdc	kHz
Minimum	20	35	---	---	---	---		---	600
Maximum	60	100	2.0	1.20	0.75	15		15	---

1/ Pulsed (see 4.4.1).

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500, and as follows:

t_{off} ---------- $t_s + t_f$

3.3 Design, construction, and physical dimensions. Transistors shall be of the design, construction, and physical dimensions shown on figure 1.

3.3.1 Lead material and finish. Lead material shall be Kovar and final finish shall be gold-plated. (Leads may be tin-coated if specified in the contract or order, and shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking (see 6.2).

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III, and as follows:

3.4.1 Process-conditioning, testing, and screening for "TX" type. Process-conditioning, testing, and screening for the "TX" types shall be as specified in 4.5.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

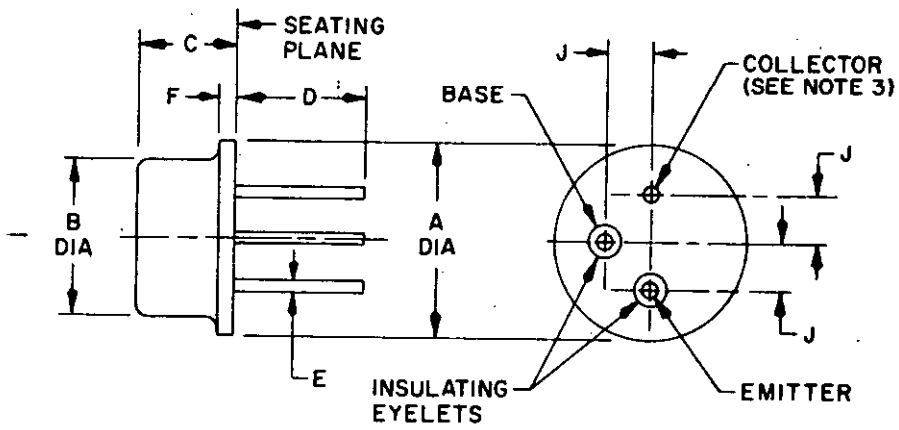
(a) Country of origin.
(b) Manufacturer's identification.

3.5.1 "TX" marking. Devices in accordance with the "TX" requirements shall include the additional marking "TX" preceding the type designation.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.550	.650	13.97	16.51	
B	.444	.524	11.28	13.31	
C	.270	.330	6.86	8.38	
D	.360	.440	9.14	11.18	5
E	.027	.033	.69	.84	2,5
F		.115		2.92	
J	.136	.146	3.45	3.71	

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond .050 (1.27 mm) from seating plane.
3. The collector shall be internally connected to the case.
4. Dimensions are in inches.
5. All three leads.

FIGURE 1. Physical dimensions of transistor types (TX and non-TX) 2N1483, 2N1484, 2N1485, and 2N1486 (TO-8).

4.2.1 Qualification testing. The non-TX types shall be used for qualification testing. (Upon request to the qualifying activity, qualification will be extended to include the "TX" type of the device.)

4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections. When specified in the contract or order, one copy of the quality conformance inspection data, pertinent to the device inspection lot shall be supplied with each shipment by the device manufacturer.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.3.3 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hours life-test, may be continued on test to 1,000 hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria, see 4.3.3.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III.

4.4.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.4.2 Time limit for end points. End point tests for qualification and quality conformance inspection shall be completed within 96 hours after completion of the last test in the subgroup.

TABLE I. Group A inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1			10	5				
Visual and mechanical examination	2071				---	---	---	---
Subgroup 2			5	2				
Breakdown voltage, collector to emitter	3011	Bias cond. D; I_C = 100 mAdc; pulsed (see 4.4.1)			BV_{CEO}			
2N1483, 2N1485						40	---	Vdc
2N1484, 2N1486						55	---	Vdc

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Units
Subgroup 2 - Continued								
Breakdown voltage, collector to base	3001	Bias cond. D; I_C = 100 μAdc			BV_{CBO}			
2N1483, 2N1485						60	---	Vdc
2N1484, 2N1486						100	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. A; V_{EB} = 1.5 Vdc; I_C = 0.25 mAdc			BV_{CEX}			
2N1483, 2N1485						60	---	Vdc
2N1484, 2N1486						100	---	Vdc
Collector to base cutoff current	3036	Bias cond. D			I_{CBO}			
2N1483, 2N1485		V_{CB} = 30 Vdc				---	15	μAdc
2N1484, 2N1486		V_{CB} = 50 Vdc				---	15	μAdc
Emitter to base cutoff current	3061	Bias cond. D; V_{EB} = 12 Vdc;			I_{EBO}	---	15	μAdc
Subgroup 3			5	3				
Forward-current transfer ratio	3076	V_{CE} = 4.0 Vdc; I_C = 750 mAdc; pulsed (see 4.4.1)			h_{FE}			
2N1483, 2N1484						20	60	---
2N1485, 2N1486						35	100	---
Collector to emitter voltage (saturated)	3071	I_C = 750 mAdc; pulsed (see 4.4.1)			V_{CE}(sat)			
2N1483, 2N1484		I_B = 75 mAdc				---	1.20	Vdc
2N1485, 2N1486		I_B = 40 mAdc				---	0.75	Vdc
Base-emitter voltage (nonsaturated)	3066	Test cond. B; V_{CE} = 4.0 Vdc; I_C = 750 mAdc; pulsed (see 4.4.1)			V_{BE}	---	2.0	Vdc
Subgroup 4			5	3				
Small-signal short-circuit forward-current transfer-ratio cutoff frequency	3301	V_{CB} = 28 Vdc; I_C = 5.0 mAdc			f_{hfb}	600	---	kHz
Pulse response	3251	Test cond. A; V_{CC} = + 12 Vdc; R_C = 15.9 ohms; $I_B(0)$ = $I_B(2)$ = 35 mAdc; $I_B(1)$ = 65 mAdc			$t_{on}+t_{off}$	---	25	μsec
Open circuit output capacitance	3236	V_{CB} = 10 Vdc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz			C_{obo}	---	400	pf

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Units
Subgroup 5			10	5				
High-temperature operation:		T_A = +175° C						
Collector to base cutoff current	3036	Bias cond. D			I_{CBO}			
2N1483, 2N1485		V_{CB} = 30 Vdc				---	1.0	mAdc
2N1484, 2N1486		V_{CB} = 50 Vdc				---	1.0	mAdc
Low-temperature operation:		T_A = -55 ±3° C						
Forward-current transfer ratio	3076	V_{CE} = 4.0 Vdc; I_C = 750 mAdc; pulsed (see 4.4.1)			h_{FE}			
2N1483, 2N1484						10	---	---
2N1485, 2N1486						17	---	---

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1			20	20				
Physical dimensions	2066	(See figure 1)			---	---	---	---
Subgroup 2			15	15				
Solderability	2026	Omit aging			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. C			---	---	---	---
Thermal shock (glass strain)	1056	Test cond. B			---	---	---	---
Terminal strength (tension)	2036	Test cond. A; weight = 10 lbs. ±10 oz; application time = 15 sec			---	---	---	---
Terminal strength (lead torque)	2036	Test cond. D1; torque = 3 in-oz; application time = 15 sec			---	---	---	---
Seal (leak-rate)	---	MIL-STD-202, method 112, test cond. C, procedure III; test cond. A for gross leaks			---	---	$1x10^{-7}$	atm cc/sec
Moisture resistance	1021	Omit initial conditioning			---	---	---	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Units
Subgroup 2 - Continued								
End points: (See 4.4.2)								
Collector to base cutoff current	3036	Bias cond. D			I_{CBO}			
2N1483, 2N1485		V_{CB} = 30 Vdc				---	15	μAdc
2N1484, 2N1486		V_{CB} = 50 Vdc				---	15	μAdc
Forward-current transfer ratio	3076	V_{CE} = 4.0 Vdc; I_C = 750 mAdc; pulsed (see 4.4.1)			h_{FE}			
2N1483, 2N1484						20	60	---
2N1485, 2N1486						35	100	---
Subgroup 3			15	15				
Shock	2016	Nonoperating; 500 G, 1.0 msec, 5 blows in each orientation: X_1, Y_1, Y_2, and Z_1			---	---	---	---
Vibration fatigue	2046	Nonoperating			---	---	---	---
Vibration, variable frequency	2056				---	---	---	---
Constant acceleration	2006	10,000 G in each orientation: X_1, Y_1, Y_2, and Z_1			---	---	---	---
End points: (Same as subgroup 2)								
Subgroup 4			20	20				
Salt atmosphere (corrosion)	1041				---	---	---	---
End points: (Same as subgroup 2)								
Subgroup 5			7	λ=5				
High-temperature life (nonoperating) (TX types only)	1031	T_{stg} = +200° C			---	---	---	---
High-temperature life (nonoperating) (Non-TX types only)	1031	T_{stg} = +200° C time = 340 hours (see 4.3.4)			---	---	---	---
End points: (See 4.4.2)								
Collector to base cutoff current	3036	Bias cond. D			I_{CBO}			
2N1483, 2N1485		V_{CB} = 30 Vdc				---	30	μAdc
2N1484, 2N1486		V_{CB} = 50 Vdc				---	30	μAdc
Forward-current transfer ratio	3076	V_{CE} = 4.0 Vdc; I_C = 750 mAdc; pulsed (see 4.4.1)			h_{FE}			
2N1483, 2N1484						15	90	---
2N1485, 2N1486						25	150	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 6			7	λ=5				
Steady-state operation life (TX types only)	1026	T_A = 25° C; V_{CE} = 32 Vdc; P_T = 1.75 W			---	---	---	---
Steady-state operation life (Non-TX types only)	1026	T_A = 25° C; V_{CE} = 32 Vdc; P_T = 1.75 W time = 340 hours (see 4.3.4)			---	---	---	---
End points: (Same as subgroup 5)								

TABLE III. Group C inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Units
Subgroup 1			10	10				
Barometric pressure, reduced (altitude operation)	1001	Normal mounting; pressure = 8 mm Hg for 60 sec min			---	---	---	---
Measurement during test:								
Collector to base cutoff current	3036	Bias cond. D			I_{CBO}			
2N1483, 2N1485		V_{CB} = 60 Vdc				---	100	μAdc
2N1484, 2N1486		V_{CB} = 100 Vdc				---	100	μAdc
Thermal resistance	3151				θ_{J-C}	---	7.0	°C/W
Subgroup 2			λ=10					
High-temperature life (nonoperating) (Non-TX types only)	1031	T_{stg} = +200° C (see 4.3.4)			---	---	---	---
End points: (Same as subgroup 5 of group B)								
Subgroup 3			λ=10					
Steady-state operation life (Non-TX types only)	1026	T_A = 25° C; V_{CE} = 32 Vdc; P_T = 1.75 W (see 4.3.4)			---	---	---	---
End points: (Same as subgroup 5 of group B)								
Subgroup 4			10	5				
Steady-state operation life	1026	100° C ≤ T_C ≤ 125° C; V_{CE} = 28 Vdc; $P_T = 10.5\ W + \frac{125°C - T_C}{7.0°C/W}$; t = 250 hours			---	---	---	---
End points: (Same as subgroup 5 of group B)								

4.5 Process-conditioning, testing, and screening for "TX" types. The procedure for process-conditioning, testing, and screening for "TX" types shall be in accordance with 4.5.1 through 4.5.8.1 and figure 2. Process-conditioning shall be conducted on 100 percent of the lot, prior to submission of the lot to the tests specified in tables I, II, and III. (At the option of the manufacturer, the non-TX type may be subjected to process-conditioning and testing.)

4.5.1 Quality assurance (lot verification). Quality assurance shall keep lot records for 3 years, minimum, monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these devices. The records shall be available for review by the customer at all times. The quality-assurance monitoring shall include, but not be limited to: process-conditioning, testing, and screening. (The conditioning and screening tests performed as standard-production tests need not be repeated when these are predesignated and acceptable to the Government as being equal to or more severe than specified herein.)

4.5.2 High-temperature storage. All devices shall be stored for at least 24 hours at a minimum temperature (T_A) of 200° C.

4.5.3 Thermal shock (temperature cycling). All devices shall be subjected to thermal shock (temperature cycling) in accordance with MIL-STD-750, method 1051, test condition C, except that 10 cycles shall be continuously performed and the time at the temperature extremes shall be 15 minutes, minimum.

4.5.4 Acceleration. All devices shall be subjected to acceleration test in accordance with MIL-STD-750, method 2006, with the following exceptions: The test shall be performed one time in the Y_1 orientation only, at a peak level of 10,000 G, minimum. The one-minute hold-time requirement shall not apply.

4.5.5 Hermetic seal (fine-leak) test. All devices shall be fine-leak tested in accordance with MIL-STD-202, method 112, test condition C, procedure IIIa or IIIb (using the applicable condition of 4.5.5.1 or 4.5.5.2), except that the gross-leak test shall be as specified in 4.5.5.3.

4.5.5.1 Conditions for procedure IIIa. The devices shall be placed in a sealed chamber and pressurized to 50 psig, minimum, with helium gas for a minimum of 4 hours. The devices shall then be removed from the chamber and within 30 minutes be subjected to a helium leak-detection test. Devices shall be rejected that exhibit a leak-rate of 5×10^{-7} cubic centimeter of helium per second when measured at a differential pressure of one atmosphere. All devices exhibiting this leakage rate or greater shall be removed from the lot.

4.5.5.2 Conditions for procedure IIIb. The devices shall be placed in a sealed chamber which shall be pressurized with krypton-85 tracer gas in a nitrogen solution for a sufficient time to detect leakages of 1×10^{-8} cubic centimeter atmospheres per second (cc-atm/sec). All devices exhibiting leakage-rates equal to or greater than 1×10^{-8} cc-atm/sec shall be removed from the lot. The devices shall be tested within a period not to exceed four hours after pressurization in the krypton-85 tracer gas.

4.5.5.3 Hermetic seal (gross-leak) test. All devices shall be tested for gross-leaks by being immersed in noncorrosive ethylene glycol at approximately 100° C for a minimum of 15 seconds and observed for bubbles. All devices that bubble shall be removed from the lot.

4.5.6 Preburn-in tests. The parameters I_{CBO} and h_{FE} of table IV shall be measured and the data recorded for all devices in the lot. All devices shall be handled or identified such that the delta end points can be determined after the burn-in test. All devices which fail to meet these requirements shall be removed from the lot and the quantity removed shall be noted on the lot history.

TABLE IV. Burn-in test measurements

Test	MIL-STD-750		Symbol	Limits		
	Method	Details		Min	Max	Unit
Collector to base cutoff current	3036	Bias cond. D	I_{CBO}			
2N1483, 2N1485		V_{CB} = 30 Vdc		---	15	μAdc
2N1484, 2N1486		V_{CB} = 50 Vdc		---	15	μAdc
Forward-current transfer ratio	3076	V_{CE} = 4.0 Vdc; I_C = 750 mAdc; pulsed (see 4.4.1)	h_{FE}			
2N1483, 2N1484				20	60	---
2N1485, 2N1486				35	100	---

4.5.7 Burn-in test. All devices shall be operated for 168 hours minimum under the following conditions:

T_A = 25 ±3° C V_{CE} = 32 Vdc P_T = 1.75 W

4.5.8 Post burn-in tests. The parameters I_{CBO} and h_{FE} of table IV shall be retested after burn-in and the data recorded for all devices in the lot. The parameters measured shall not have changed during the burn-in test from the initial value by more than the specified amount as follows:

ΔI_{CBO} = 100 percent or ±3 microamperes, whichever is greater.

Δh_{FE} = ±25 percent.

4.5.8.1 Burn-in test failures (screening). All devices that exceed the delta (Δ) limits of 4.5.8 or the limits of table IV after burn-in, shall be removed from the inspection lot and the quantity removed shall be noted on the lot history. If the quantity removed after burn-in should exceed 10 percent of the total-inspection lot on the burn-in test, then the entire lot shall be unacceptable for the "TX" types.

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES:

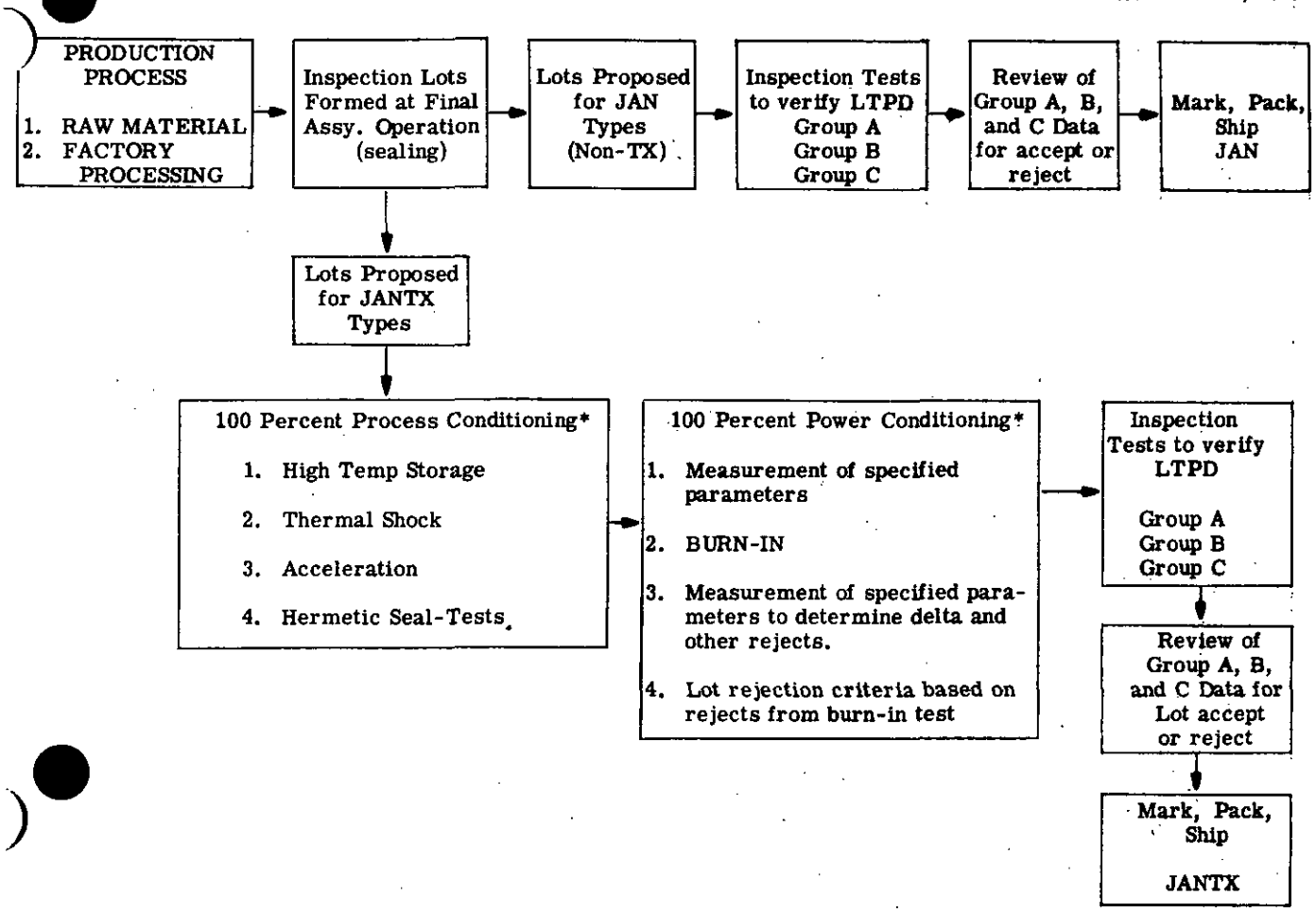
6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Ordering data.

(a) Lead finish if other than gold-plated Kovar (see 3.3.1).
(b) Inspection data (see 4.3).

6.3 Substitution criteria. The non-TX types covered herein are interchangeable with the corresponding types covered by the superseded MIL-S-19500/180C (EL).

6.4 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.



*ORDER OF THE TESTS IN THE BLOCKS SHALL BE PERFORMED AS SHOWN

FIGURE 2. Order of procedure diagram for JAN (Non-TX) and JANTX types.

Custodians:
Army - EL
Navy - SH
Air Force - 11

Review activities:
Army - EL, MU, MI
Navy - SH
Air Force - 11, 17, 85

User activities:
Army - EL, SM
Navy - CG, MC, AS, OS
Air Force - 19

Preparing activity:
Army - EL

(Project 5961-0009-18)

Code "C"